SHALLOWLY BURIED HYDROGENATION IN THE LUNAR REGOLITH: USING ALBEDO PROTONS TO REFINE TRENDS IN LATITUDE AND LOCAL TIME. J. K. Wilson[1], N. A. Schwadron[1], A. P. Jordan[1], H. E. Spence[1], M. D. Looper[2], L. W. Townsend[3], F. Zaman[3], W. de Wet[3], [1]University of New Hampshire, Space Science Center and Inst. of Earth, Oceans and Space, Morse Hall, 8 College Rd, Durham, NH 03824, USA (jody.wilson@unh.edu), [2]The Aerospace Corporation, El Segundo, CA 90245-4609, USA, [3]University of Tennessee, Knoxville, TN, 37996, USA.

Summary: Now that the CRaTER instrument on LRO has tentatively detected excess hydrogen or hydrogen-bearing molecules in the lunar regolith both near the dawn terminator [1] and near the poles [2], we are exploring multiple avenues to better quantify the degree of lunar hydrogenation in the top 10 cm of regolith as a function of latitude and time of day.

Expanding horizon-viewing coverage: Horizon-viewing observations by CRaTER are particularly sensitive to forward-scattering knock-on collisions of galactic cosmic rays (GCRs) with hydrogen in the upper few cm of soil [3], as illustrated in Figure 1. Schwadron et al. [1] used our first horizon-viewing data from 2015 to show that the yield of ~100 MeV lunar albedo protons is twice as great at local lunar sunrise than at sunset, suggesting an enhanced abundance of hydrogenation in the cool pre-sunrise lunar regolith compared to the warmer regolith at sunset.

In addition to making use of untapped horizon data from 2016 and 2017, we are also planning horizon-viewing observations over all lunar night-time hours in 2018 to test whether this hydrogenation gradually builds up during the lunar night, or whether it occurs in a pre-sunrise "standing wave" as hypothesized by Schorghofer [4]. The former case would suggest that there is an efficient method of transporting and trapping hydrogen to the entire night-side hemisphere of the Moon, while the latter case would suggest that the dawn hydrogen enhancement is mostly a manifestation of a localized diffusion "wind" from the warm side of the dawn terminator to the cold side.

Improved data analysis of the latitude trend: Schwadron et al. [2] used an early form of collimated CRaTER data analysis [5] to create a coarse plot of the lunar albedo proton yield vs. latitude, and found a ~1% enhancement of the yield near the poles compared to the equator, suggesting a polar hydrogen enhancement in the top 10 cm of regolith. The sparse horizon data used in the subsequent sunrise/sunset study [1] inspired a new and improved collimated data reduction technique which we will use to improve the resolution and signal-to-noise ratio of the albedo proton latitude trend. This will help to bridge the hydrogen latitude trends seen by other instruments at the surface (< 1 mm) and at depth (~50 cm) [6].

References: [1] Schwadron N., et al. (2017), PSS, [2] Schwadron, N., et al. (2016), Icarus, 273, 25-35, [3] de Wet, W. et al. (2018) LPSC meeting, [4] Schorghofer, N. (2014), GRL, 41, 4888-4893, [5] Wilson, J.K., et al. (2012), JGR, 117, E00H23, [6] Jordan, A.P., et al. (2018, this meeting)

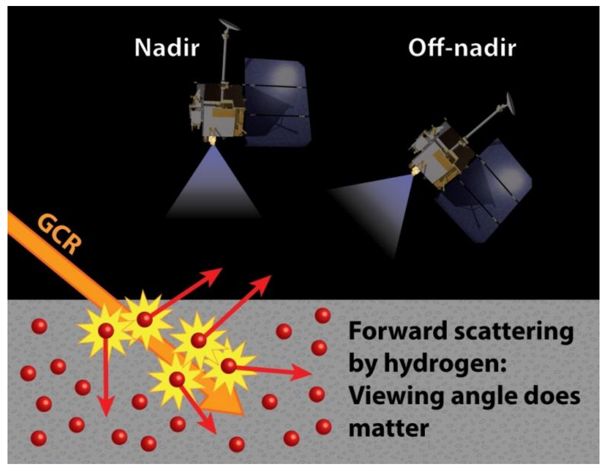

Figure 1. The orientation of CRaTER's field of view relative to the lunar horizon affects CRaTER's sensitivity to the products of forward-scattering (knock-on) collisions of GCRs with hydrogen atoms in the lunar regolith.